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Measured resolved shear stresses and active slip systems in austenitic steel

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With the purpose of determining the critically stressed slip systems in a tensile deformed austenitic stainless steel, the full stress tensor is measured for 150 individual bulk grains using 3DXRD microscopy at CHESS. The measured stress states are further compared to the theoretical Bishop-Hill states. In the elastic regime, the resolved shear stresses exhibit quite large variations between grains of similar orientation. On average, however, the resolved shear stresses agree well with the Schmid factors for uniaxial tension. In the plastic regime at 1% elongation, about half of the grains were close to a Bishop-Hill state. The orientation dependence of the Bishop-Hill state was, however, not exactly as expected. The other half of the grains was closer to the applied uniaxial stress, in between two Bishop-Hill stress states, or in some cases none of these. Comparison to finite-element crystal plasticity simulations only qualitatively agree.